

TEST REPORT

Application No.: SHCR2108000032AT
FCC ID: 2A5PE-YUSHU001
Applicant: Unitree
Address of Applicant: 3rd Floor, Building 1, Fengda Creative Park, No. 88 Dongliu Road, Binjiang District, Hangzhou, Zhejiang, China
Manufacturer: Unitree
Address of Manufacturer: 3rd Floor, Building 1, Fengda Creative Park, No. 88 Dongliu Road, Binjiang District, Hangzhou, Zhejiang, China
Factory: Unitree
Address of Factory: 3rd Floor, Building 1, Fengda Creative Park, No. 88 Dongliu Road, Binjiang District, Hangzhou, Zhejiang, China
Equipment Under Test (EUT):
EUT Name: Quadruped Robot
Model No.: Go1,Go1 Air,Go1 Edu,Go1 Pro,Go1 Max,Go1 Nx,Go1 Pro Max
 Please refer to section 2 of this report which indicates which model was actually tested and which were electrically identical.
Standard(s) : 47 CFR Part 15, Subpart F 15.519
Date of Receipt: 2021-09-02
Date of Test: 2021-11-05 to 2022-01-07
Date of Issue: 2022-02-24

Test Result:	Pass*
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* In the configuration tested, the EUT complied with the standards specified above.

Parlam Zhan

Parlam Zhan
Laboratory Manager



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**SGS-CSTC Standards Technical Services
(Shanghai) Co., Ltd.**

Report No.: SHCR210800003203

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Revision Record			
Version	Description	Date	Remark
00	Original	2022-02-24	/

Authorized for issue by:			
		<i>Wade Zhang</i>	
		Wade Zhang / Project Engineer	
		<i>Parlam Zhan</i>	
		Parlam Zhan / Reviewer	



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SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd.
Testing Center EMC

NO. 588 West Jindu Road, Songjiang District, Shanghai, China 201612
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2 Test Summary

Test Item	Test Requirement	Test method	Result
Antenna Requirement	47 CFR Part 15, Subpart C Section 15.203 & Subpart F Section 15.519 (a)(2) & 15.521(b)	ANSI C63.10 (2013)	PASS
UWB Bandwidth	47 CFR Part 15, Subpart F Section 15.503 (a) & 15.521(e)	ANSI C63.10 (2013)	PASS
Dwell Time	47 CFR Part 15, Subpart F Section 15.519 (a)(1)	ANSI C63.10 (2013)	PASS*
Spurious Emissions	47 CFR Part 15, Subpart F Section 15.519 (c)(d)/15.209 & 15.521 (c)(d)(h)	ANSI C63.10 (2013)	PASS
EIRP	47 CFR Part 15, Subpart F Section 15.519 (e) & 15.521(g)	ANSI C63.10 (2013)	PASS

Declaration of EUT Family Grouping:

Note: There are series models mentioned in this report, and they are the similar in electrical and electronic characters. Only the model Go1 was tested since their differences were the model number and appearance.

Remark: for 47 CFR Part 15.521 General Requirement, Section 15.521(f)(i), is not applicable for this product, so it's not evaluated in the report.



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4 General Information

4.1 Details of E.U.T.

Power supply:	DC 22.2V 6Ah Battery
Charger:	Model: KS150DU-2520600
	Input: AC 100-240V, 50/60Hz, 2.5A
	Output: DC 25.2V 6.0A
Test voltage:	DC 22.2V
Location for use:	Indoors and Outdoors
Antenna Gain:	0dBi (Provided by manufacturer)
Antenna Type:	Dipole Antenna
Modulation Type:	BPM-BPSK
Number of Channels:	1
Frequency range:	4492.8MHz (3100MHz-10600MHz)

4.2 Description of Support Units

The EUT has been tested as an independent unit.

4.3 Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	Radio Frequency	8.4 x 10 ⁻⁸
2	Timeout	2s
3	Duty Cycle	0.37%
4	Occupied Bandwidth	3%
5	RF Radiated Power	5.1dB (Below 1GHz)
		4.9dB (Above 1GHz)
6	Radiated Spurious Emission Test	4.2dB (Below 30MHz)
		4.5dB (30MHz-1GHz)
		5.1dB (1GHz-18GHz)
		5.4dB (Above 18GHz)
7	Temperature Test	1°C
8	Humidity Test	3%
9	Supply Voltages	1.5%
10	Time	3%

Note: The measurement uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.



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4.4 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd. Shanghai Branch

588 West Jindu Road, Xinqiao, Songjiang, 201612 Shanghai, China

Tel: +86 21 6191 5666

Fax: +86 21 6191 5678

No tests were sub-contracted.

4.5 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **CNAS (No. CNAS L0599)**

CNAS has accredited SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. to ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

- **A2LA (Certificate No. 6332.01)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. is accredited by the American Association for Laboratory Accreditation(A2LA).

- **FCC (Designation Number: CN1301)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been recognized as an accredited testing laboratory.

- **ISED (CAB Identifier: CN0020)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. EMC Laboratory has been recognized by Innovation, Science and Economic Development Canada (ISED) as an accredited testing laboratory. Company Number: 8617A

- **VCCI (Member No.: 3061)**

The 3m Semi-anechoic chamber and Shielded Room of SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-13868, C-14336, T-12221, G-10830 respectively.

4.6 Deviation from Standards

None

4.7 Abnormalities from Standard Conditions

None



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5 Equipment List

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
RF Conducted Test					
Spectrum Analyzer	R&S	FSP-30	SHEM002-1	2021-12-20	2022-12-19
Spectrum Analyzer	Keysight	N9020B	SHEM241-1	2021-08-30	2022-08-29
Spectrum Analyzer	Agilent	N9020A	SHEM181-1	2021-08-13	2022-08-12
Signal Generator	R&S	SMR20	SHEM006-1	2021-08-13	2022-08-12
Signal Generator	Agilent	N5182A	SHEM182-1	2021-08-13	2022-08-12
Communication Tester	R&S	CMW270	SHEM183-1	2021-07-28	2022-07-27
Communication Tester	R&S	CMW500	SHEM183-2	2021-04-16	2022-04-15
Switcher	Tonscend	JS0806	SHEM184-1	2021-08-13	2022-08-12
Power Sensor	Keysight	U2021XA * 4	SHEM184-1	2021-08-13	2022-08-12
Splitter	Anritsu	MA1612A	SHEM185-1	/	/
Coupler	e-meca	803-S-1	SHEM186-1	/	/
High-low Temp Cabinet	Suzhou Zhihe	TL-40	SHEM087-1	2019-09-25	2022-09-24
AC Power Stabilizer	APC	KDF-31020T-V0-F0	SHEM216-1	2021-12-20	2022-12-19
DC Power Supply	MCH	MCH-303A	SHEM210-1	2021-12-20	2022-12-19
Conducted test Cable	/	RF01~RF04	/	2021-12-20	2022-12-19
Test software	Tonscend	JS Tonscend BT/WIFI System	Version: 2.6	/	/
RF Radiated Test					
EMI test Receiver	R&S	ESU40	SHEM051-1	2021-12-20	2022-12-19
Spectrum Analyzer	R&S	FSP-30	SHEM002-1	2021-12-20	2022-12-19
Communication Tester	R&S	CMW500	SHEM183-2	2021-04-16	2022-04-15
Loop Antenna (9kHz-30MHz)	Schwarzbeck	FMZB1519	SHEM135-1	2021-12-20	2022-12-19
Antenna (25MHz-2GHz)	Schwarzbeck	VULB9168	SHEM048-1	2021-09-11	2023-09-10
Antenna (25MHz-2GHz)	Schwarzbeck	VULB9168	SHEM202-1	2020-04-30	2022-04-29
Horn Antenna (1-18GHz)	Schwarzbeck	HF906	SHEM009-1	2019-10-24	2022-10-23
Horn Antenna (1-18GHz)	Schwarzbeck	BBHA9120D	SHEM050-1	2021-09-18	2023-09-17
Horn Antenna (14-40GHz)	Schwarzbeck	BBHA 9170	SHEM049-1	2021-09-18	2023-09-17
Pre-Amplifier	HP	8447D	SHEM236-1	2021-05-27	2022-05-26
Pre-Amplifier	PANSHAN	LNA 1-18G	SHEM235-1	2021-05-27	2022-05-26
High-amplifier (14-40GHz)	Schwarzbeck	10001	SHEM049-2	2021-12-20	2022-12-19
Band Filter	LORCH	9BRX-875/X150	SHEM156-1	/	/
Band Filter	LORCH	13BRX-1950/X500	SHEM083-2	/	/
Band Filter	LORCH	5BRX-2400/X200	SHEM155-1	/	/
Band Filter	LORCH	5BRX-5500/X1000	SHEM157-2	/	/
High pass Filter	Wainwright	WHK3.0/18G	SHEM157-1	/	/
High pass Filter	Wainwright	WHKS1700	SHEM157-3	/	/
Semi/Fully Anechoic	ST	11*6*6M	SHEM078-2	2020-05-25	2023-05-24
RE test Cable	/	RE01, RE02, RE06	/	2021-12-20	2022-12-19
Test software	ESE	E3	Version: 6.111221a	/	/



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6 Radio Spectrum Technical Requirement

6.1 Antenna Requirement

6.1.1 Test Requirement:

47 CFR Part 15, Subpart C 15.203 & 15.519(a)(2) & 15.521(b)

6.1.2 Conclusion

Standard Requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.519(a) (2) requirement:

The use of antennas mounted on outdoor structures, e.g., antennas mounted on the outside of a building or on a telephone pole, or any fixed outdoors infrastructure is prohibited. Antennas may be mounted only on the hand held UWB device.

EUT Antenna:

The antenna is dipole antenna and no consideration of replacement. The best case gain of the antenna is 0dBi.

Antenna location: Refer to Appendix (Internal Photos)

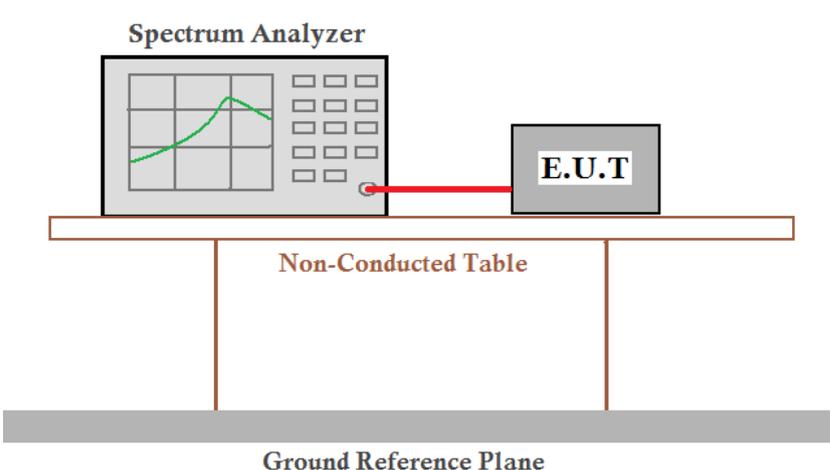


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7 Radio Spectrum Matter Test Results

7.1 UWB Bandwidth (10dB Bandwidth)

Test Requirement:	47 CFR Part 15F Section 15.503(a) & 15.521(e)
Test Method:	ANSI C63.10:2013
Test Setup:	
Limit:	≥500MHz
Exploratory Test Mode:	Transmitter mode
Instruments Used:	Refer to section 4 for details
Test Results:	Pass

Measurement Data

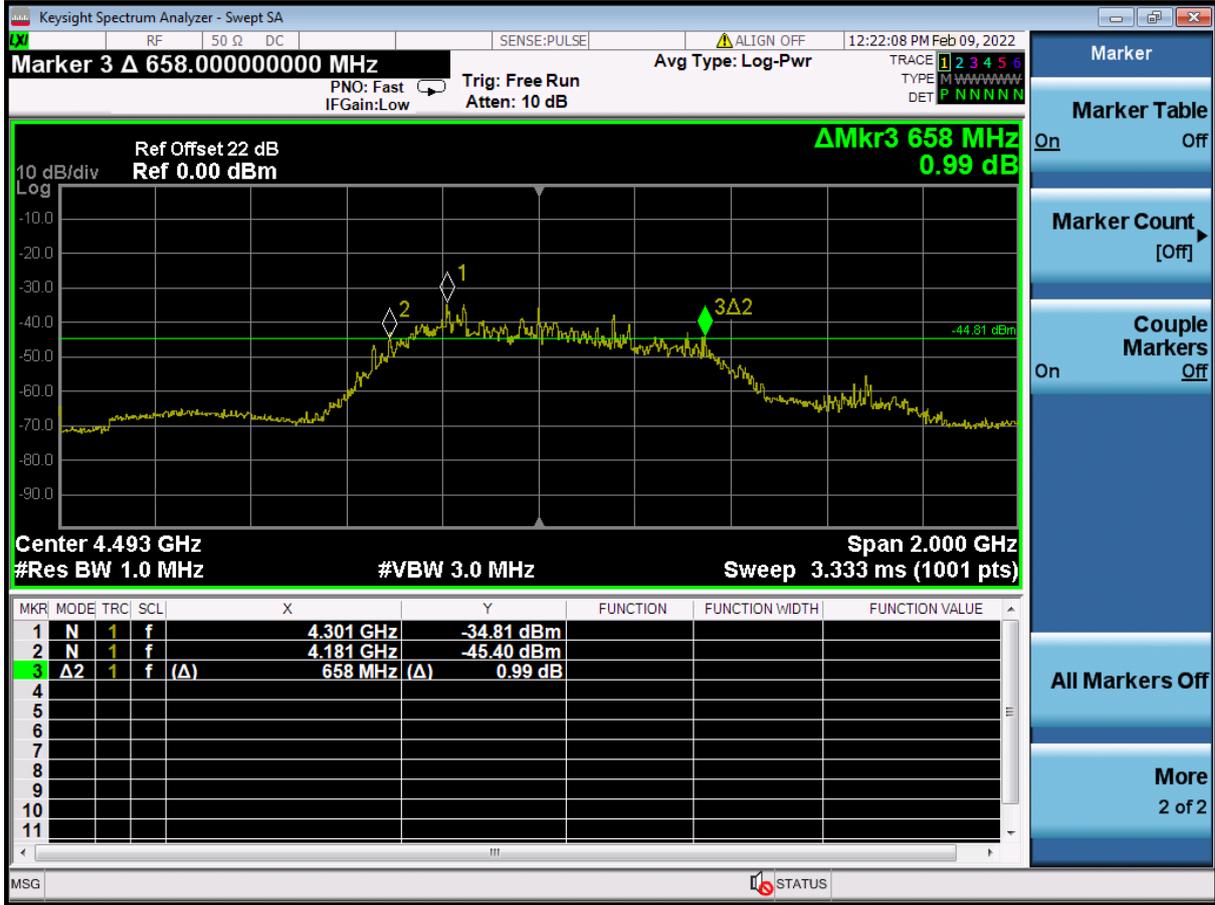
Test Frequency (MHz)	F _L (MHz)	F _H (MHz)	10dB bandwidth (MHz)	Limit (MHz)	Results
4492.8	4181	4839	658	≥500MHz	Pass



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Test plot as follows:



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7.2 Radiated Spurious Emissions

Test Requirement:	47 CFR Part 15, Subpart F Section 15.519 (c)(d)/15.209 & 15.521 (c)(d)(g)(h)				
Test Method:	ANSI C63.10: 2013				
Test Site:	Measurement Distance: 3m				
Receiver Setup:	Frequency	Detector	RBW	VBW	Remark
	0.009MHz-0.090MHz	Peak	10kHz	30kHz	Peak
	0.009MHz-0.090MHz	Average	10kHz	30kHz	Average
	0.090MHz-0.110MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
	0.110MHz-0.490MHz	Peak	10kHz	30kHz	Peak
	0.110MHz-0.490MHz	Average	10kHz	30kHz	Average
	0.490MHz -30MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
	30MHz-960MHz	Quasi-peak	100 kHz	300kHz	Quasi-peak
	Above 960MHz	RMS	1MHz	3MHz	RMS
Limit: (Spurious Emissions)	Frequency	Field strength (microvolt/meter)	Limit (dBuV/m)	Remark	Measurement distance (m)
	0.009MHz-0.490MHz	2400/F(kHz)	-	-	300
	0.490MHz-1.705MHz	24000/F(kHz)	-	-	30
	1.705MHz-30MHz	30	-	-	30
	30MHz-88MHz	100	40.0	Quasi-peak	3
	88MHz-216MHz	150	43.5	Quasi-peak	3
	216MHz-960MHz	200	46.0	Quasi-peak	3
	960MHz-1610MHz	-75.3 dBm (EIRP, RBW=1MHz)		RMS	3
	1610MHz-1990MHz	-63.3 dBm (EIRP, RBW=1MHz)		RMS	3
	1990MHz-3100MHz	-61.3 dBm (EIRP, RBW=1MHz)		RMS	3
	3100MHz-10600MHz	-41.3 dBm (EIRP, RBW=1MHz)		RMS	3
	3100MHz-10600MHz	0 dBm (EIRP, RBW=50MHz)		Peak	3
	Above 10600MHz	-61.3 dBm (EIRP, RBW=1MHz)		RMS	3
	1164MHz-1240MHz	-85.3 dBm (EIRP, RBW=1kHz)		RMS	3
	1559MHz-1610MHz	-85.3 dBm (EIRP, RBW=1kHz)		RMS	3



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Test Setup:

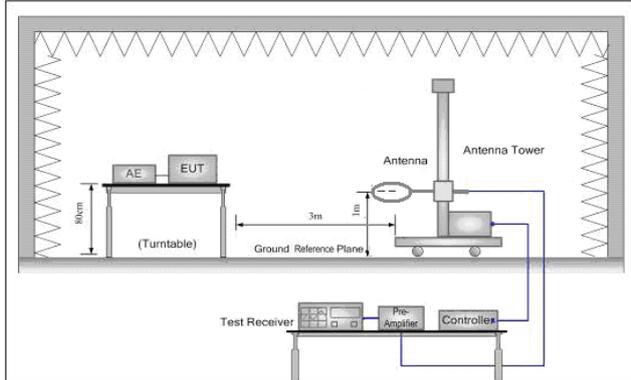


Figure 1. Below 30MHz

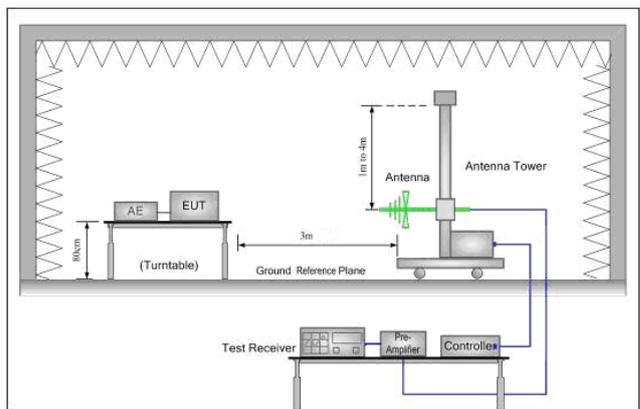


Figure 2. 30MHz to 1GHz

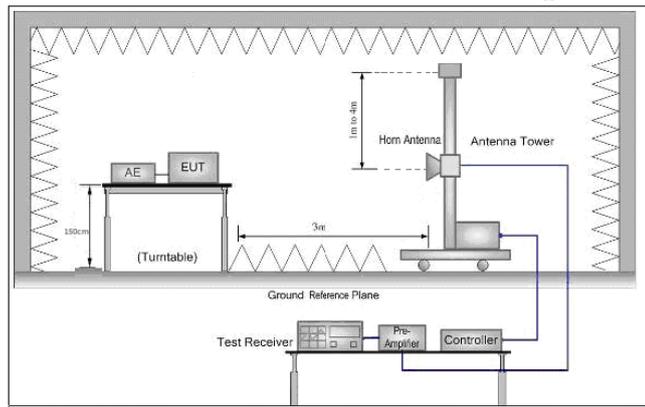


Figure 3. Above 1 GHz

Test Procedure:

- 1) For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- 2) For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- 3) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- 4) The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- 5) For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to



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	<p>heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.</p> <p>6) The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.</p> <p>7) If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.</p> <p>8) Test the EUT in the lowest channel,the middle channel,the Highest channel</p> <p>9) The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode,And found the X axis positioning which it is worse case.</p> <p>10) Repeat above procedures until all frequencies measured was complete.</p> <p>11) Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor</p>
Exploratory Test Mode:	Transmitting mode
Final Test Mode:	Transmitting mode
Instruments Used:	Refer to section 4 for details
Test Results:	Pass

According to ANSI 63.10 Clause 10.3.9, the EIRP to field strength at a specified measurement distance of 3 m is below:

$$E \text{ (dBuV/m)} = \text{EIRP(dBm)} + 95.3$$

Thus, the field strength limit for the test above 1GHz is below:

Frequency	Limit		Detector	Measurement Distance
	EIRP (dBm)	Field Strength (dBuV/m)		
960MHz-1610MHz	-75.3 (RBW=1MHz)	20.00	RMS	3
1610MHz-1990MHz	-63.3 (RBW=1MHz)	32.00	RMS	3
1990MHz-3100MHz	-61.3 (RBW=1MHz)	34.00	RMS	3
3100MHz-10600MHz	-41.3 (RBW=1MHz)	54.00	RMS	3
3100MHz-10600MHz	0 (RBW=50MHz)	95.30	Peak	3
Above 10600MHz	-61.3 (RBW=1MHz)	34.00	RMS	3
1164MHz-1240MHz	-85.3 (RBW=1kHz)	10.00	RMS	3
1559MHz-1610MHz	-85.3 (RBW=1kHz)	10.00	RMS	3



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Measurement Data

7.2.1.1 Peak Power

Frequency (MHz)	Measured Radiated Output Power (dBm)	EIRP + Duty Cycle Correction Factor (99%)	Limit (dBm)	Over Limit(dB)	Polarization
4492.8	-53.61	-53.61	-41.30	-12.31	Horizontal
4492.8	-55.33	-55.33	-41.30	-14.03	Vertical

Duty cycle: >99%

7.2.1.2 Peak Power Density

Peak Power Density @ RBW=50MHz						
Frequency (MHz)	Measured Peak Power Density (dBm)	Calculated factor for RBW=8MHz to RBW=50MHz	Calculated Peak Power Density (dBm)	Limit (dBm)	Over Limit(dB)	Polarization
4492.8	-21.76	15.92	-5.84	0	-5.84	Horizontal
4492.8	-23.65	15.92	-7.73	0	-7.73	Vertical

Note: Calculated Peak Power Density = Measured Peak Power Density@8MHz + 20log(50MHz/8MHz)

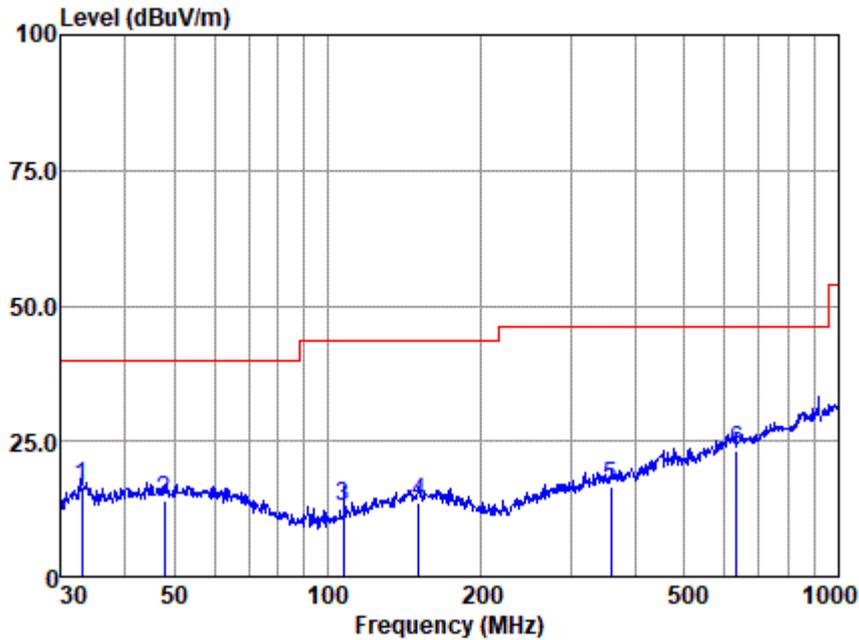


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7.2.1.3 Spurious Emissions

30MHz-960MHz



Antenna Polarity :VERTICAL

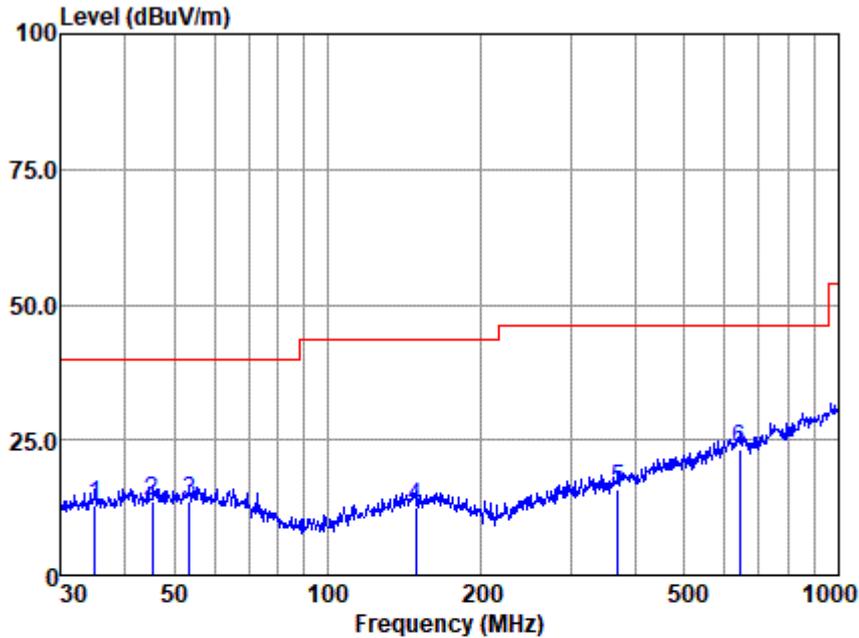
	Read	Antenna	Cable	Preamp	Emission	Limit	Over	
Freq	Level	Factor	Loss	Factor	Level	Line	Limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	32.979	29.14	12.61	1.01	26.20	16.56	40.00	-23.44 QP
2	47.826	25.32	13.83	1.15	26.20	14.10	40.00	-25.90 QP
3	107.510	28.03	10.03	1.79	27.10	12.75	43.50	-30.75 QP
4	151.067	25.26	13.19	2.13	27.10	13.48	43.50	-30.02 QP
5	359.186	25.39	14.74	3.25	26.69	16.69	46.00	-29.31 QP
6	633.907	25.52	20.71	4.38	27.20	23.41	46.00	-22.59 QP

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor



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Antenna Polarity :HORIZONTAL

	Read Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	35.005	25.20	12.85	1.01	26.20	12.86	40.00	-27.14	QP
2	45.375	24.77	13.75	1.16	26.20	13.48	40.00	-26.52	QP
3	53.505	24.75	13.74	1.23	26.20	13.52	40.00	-26.48	QP
4	148.441	24.36	13.07	2.08	27.10	12.41	43.50	-31.09	QP
5	370.702	24.35	15.13	3.28	26.86	15.90	46.00	-30.10	QP
6	640.611	25.35	20.68	4.44	27.20	23.27	46.00	-22.73	QP

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor



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Test Data:

Transmitting with modulation Mode								
Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
1164MHz ≤ f ≤ 1240MHz & 1559MHz ≤ f ≤ 1610MHz								
1213.42	25.43	1.93	37.07	15.65	5.94	10.00	-4.06	Vertical
1577.31	25.75	2.12	37.00	15.23	6.10	10.00	-3.90	Vertical
960MHz ≤ f ≤ 3100MHz (except for above frequency range)								
1116.29	25.13	1.88	37.10	23.42	13.33	20.00	-6.67	Vertical
2334.33	29.12	2.97	37.59	27.36	21.86	34.00	-12.14	Vertical
f > 3100MHz								
3622.31	32.41	4.40	38.40	43.57	41.98	54.00	-12.02	Vertical
4528.43	32.72	4.55	38.49	44.61	43.39	54.00	-10.61	Vertical
6623.12	35.77	5.94	37.97	43.34	47.08	54.00	-6.92	Vertical
12132.32	38.78	6.53	37.05	19.44	27.70	34.00	-6.30	Vertical
14653.16	41.84	8.83	38.30	17.45	29.82	34.00	-4.18	Vertical
15123.42	42.33	9.80	37.32	13.43	28.24	34.00	-5.76	Vertical
1164MHz ≤ f ≤ 1240MHz & 1559MHz ≤ f ≤ 1610MHz								
1171.23	25.11	1.64	37.38	17.53	6.90	10.00	-3.10	Horizontal
1565.55	25.67	1.88	37.08	15.32	5.79	10.00	-4.21	Horizontal
960MHz ≤ f ≤ 3100MHz (except for above frequency range)								
1121.34	24.59	1.60	37.02	26.42	15.59	20.00	-4.41	Horizontal
1971.26	27.76	2.13	37.11	31.42	24.20	34.00	-9.80	Horizontal
f > 3100MHz								
3755.23	32.68	4.00	37.24	49.33	48.77	54.00	-5.23	Horizontal
6408.32	35.54	5.50	38.36	48.45	51.13	54.00	-2.87	Horizontal
7132.32	36.07	5.55	38.24	46.42	49.80	54.00	-4.20	Horizontal
12213.56	38.44	6.72	37.25	33.55	41.46	34.00	7.46	Horizontal
13123.42	39.30	7.18	37.00	21.53	31.01	34.00	-2.99	Horizontal
14235.64	40.21	8.32	37.51	17.53	28.55	34.00	-5.45	Horizontal

Remark:

- 1) Scan from 9kHz to 40GHz, the disturbance above 18GHz and below 30MHz was very low, and the above harmonics were the highest point could be found when testing, so only the above harmonics had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.



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7.3 Dwell Time

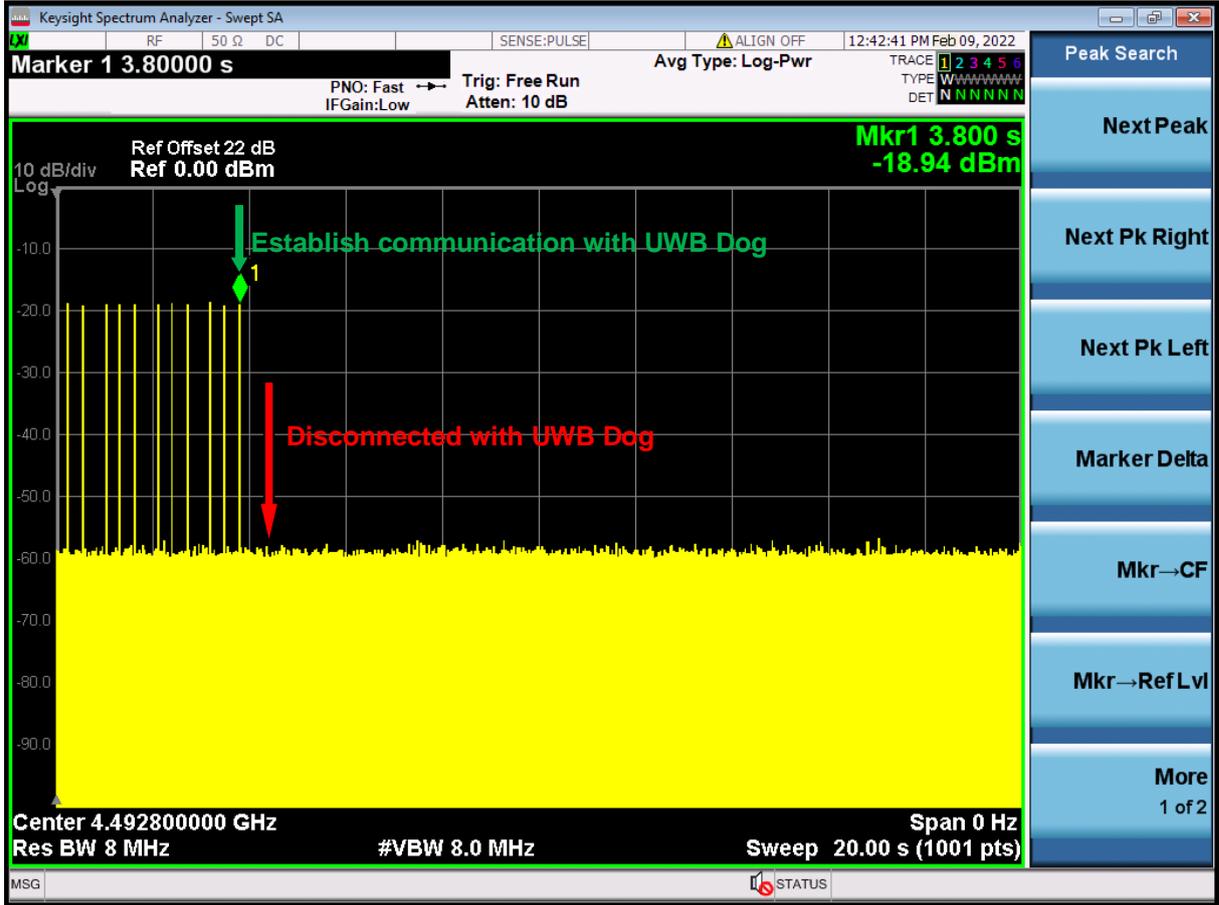
Test Requirement:	47 CFR Part 15F Section 15.519(a)(1)
Test Method:	ANSI C63.10:2013
Test Setup:	<p>The diagram illustrates the test setup. A Spectrum Analyzer is connected via a red cable to an E.U.T. (Equipment Under Test). Both are placed on a Non-Conducted Table. Below the table is a Ground Reference Plane.</p>
Limit:	The UWB intentional radiator shall cease transmission within 10 seconds unless it receives an acknowledgement from the associated receiver that its transmission is being received
Exploratory Test Mode:	Operation mode
Instruments Used:	Refer to section 4 for details
Test Results:	Pass*

Measurement Data

The UWB Tag is a real-location system, When UWB Label remote not establish communication with UWB dog, then they will cease transmission. So, they are satisfied the requirement for 47 CFR Part 15F Section 15.519(a)(1).



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8 Test Setup Photographs

Refer to the < Test Setup photos-FCC >.

9 EUT Constructional Details

Refer to the < External Photos > & < Internal Photos >.

- End of the Report -



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